The Use of Computer Telephony to Provide Interactive Health Information

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ABSTRACT

The use of information technology to provide health information to the public has grown at a rapid pace. Numerous sources of health care information within both the print and Internet media are now available. Yet, their availability raises concerns about the quality of the information provided and questions about which is the most effective method for transmitting health information to consumers. We present an interactive method of presenting high-quality health information that uses a new approach: an integration of the telephone and the computer also called computer telephony. Telephone-Linked Communication for Health Information (TLC-HI) is a computer-based telecommunications system that functions as an educator to people in search of answers to health-related issues. To create TLC-HI, we converted validated print-based consumer information into computer-controlled conversational dialogues. We discuss the potential that the TLC-HI approach holds for improving the way health information is communicated.

INTRODUCTION

Consumer interest in obtaining health information has increased and will likely continue to increase in the future.[1,2,3] Individuals gather health information through a wide variety of means. The traditional medium has been printed materials, but in recent years this information has been available electronically over the Internet.[3] Approximately 45% of Internet users access health information.[4] However, at least one-third of Internet users are dissatisfied with the quality of health care information on the World Wide Web.[5] According to both patients and health care professionals, accuracy of information is the most important problem with medical information on the Internet.[6,7,8] Therefore, a system that can provide high quality information in a controlled interactive setting may improve the delivery of heath care information and satisfy consumers' needs.

Print Medium

The most common sources of health information are publications such as newsletters, brochures and books. While the print medium can achieve a balance between the amount of material presented and the level of complexity of the material, it cannot control the flow of information to be read. Due to the conventional linear structure of printed materials, to fully understand an article one must read it sequentially. While the reader is in control of selecting what he reads, there is no interactivity and there is little ability to drill-down into more detail if so desired.

The World Wide Web – Internet

The explosion of the World Wide Web offers new ways to convey health information to the consumer. In fact, as stated above, one of the most common reasons people use the Internet is to obtain health information.[1] While storing health information for consumers on Web sites is relatively easy to set up, making sure that readers see, understand, and retain crucial pieces of information at a Web site is much more difficult to achieve. Given that most of the Internet sites are set up as electronic museums of printed materials, we are faced with the same limitations as the print medium discussed above. In addition, the World Wide Web contains a large amount of incomplete and misleading information[7,8,9] which results in a high level of user dissatisfaction with the general quality of health care information on the Internet.[5]

Also, a question of relevance of the information present on a single Web page arises. Information retrieval depends upon the subjective judgment of a particular person at a particular time.[9] However, the freedom of the user to access material of his or her choosing, may skew the transfer of information from what the designer intended.

Access to the Internet, in general, and to health care information Web sites, in particular, differs by socioeconomic status and other demographic factors. The "digital divide", however, is much less of an

issue for health information communications that use other channels of communication. In this paper we will discuss an alternative approach to health information dissemination through the use of telephony systems. In the U.S., almost all people have ready access to telephones.

Computer Telephony

Since 1990, significant technological developments have simplified computer-telephone systems and increased the marketplace's interest in computer telephony.[10] Automated telephone systems are incorporated into the health care system through applications that deal with appointment and patient reminders, patient monitoring in chronic diseases, treatment programs, and interventions targeted towards specific health behavior changes.[11] We have developed one of the first interactive computer-based telecommunication systems that "speaks" to patients and other consumers using computer controlled speech.[12] The Telephone-Linked Communication (TLC) System converses with people in their home or offices over their telephone, and they, in turn, respond by pressing the numbers on their touch-tone telephone keypads or by speaking into the receiver. A number of studies indicate that TLC is well accepted by patients and by their providers while its use produces significant positive health outcomes[11]. TLC telephony may serve as a new medium for providing health information to the public that addresses some of the limitations of print and Internet media.

HEALTH INFORMATION THROUGH COMPUTER TELEPHONY: TLC-HEALTH INFORMATION

In an attempt to present an alternative way of providing the public with health information, we developed a new concept for delivering interactive health communications based on computer telephony. The Telephone-Linked Communication for Health Information (TLC-HI) system conveys information efficiently, presenting it in a condensed form, and facilitates interaction between a user and a computer through a telephone interface. Interactivity has been shown to be a crucial element in the learning process[13]. Lack of interaction in written documents may adversely affect the retention of health information. Although consumer use of the Internet is interactive, it does not generally share a crucial feature of computer telephony, the controlled presentation of material. By condensing information into short computer controlled dialogs, whose delivery is prospectively determined by user input, the TLC-HI ensures that only relevant material is communicated to the users. TLC-HI interacts with the user through "conversations" that preserves the user's focus by constant interaction and feedback. TLC-HI offers a variety of health information topics which are broken down into subtopics. TLC-HI navigates the user through the conversation, but it's left to the user to choose which path in the conversation to take. Regardless of the selection, the logical order of the "conversation" is always preserved in such a way that a skipped subtopic doesn't prevent a user from understanding the following subtopic.

System Architecture and Software Design

The TLC-HI system hardware consists of two linked computers systems. One system is responsible for execution of stored dialogues or "conversations". Each dialogue is stored as a voice file of previously recorded human speech. The dialogues are managed by an expert system which is composed of a number of programmed scripts. The second computer system stores data in a database. The two subsystems communicate with each other on every TLC call. Upon receiving a call, the first system initializes the instruction to "speak" a greeting and asks for the user to provide a password. Once the authorization is confirmed, TLC retrieves data on the user's profile from the database and invokes an appropriate greeting. From that point on, direct interaction with a user is maintained through questions that TLC "asks" the user and responses it receives. Many of the choices that the user makes are stored as variables in the database and can be used during the current conversation or in a future one. An extended description of the TLC architecture can be found elsewhere[11].

Dialogue Development

The development of TLC-HI consisted of four major steps. The first step involved identifying clinical content that would be used as the basis for the TLC-HI dialogues. We required that this content be directed to the lay public and be current. We partnered with the Harvard Health Publications and used their general health information journal, the Harvard Health Letter, as the basis for the clinical content for TLC-HI.

The second step involved selecting the specific topics from recent Harvard Health Letter articles. The topics selected were common, up-to-date and of appeal to the general population. They span the breadth of health information including common symptoms such as fatigue, low back pain and

headaches; common medical conditions such as allergies, colds and asthma; information about medications such as how to avoid medication errors, preventive medicine topics such as vaccinations, and information about the health care system such as choosing an HMO.

The third and most time-intensive development phase involved designing interactive conversations. For this task, an MPH student and a nurse under the supervision of a medical informatics internist developed the specific dialogues for each topic. This required identifying and organizing subtopics, determining branching points and devising an algorithm for each conversation. The specific information in the Harvard Health Letter articles was converted to health questions, a closed set of answers and feedback for each answer.

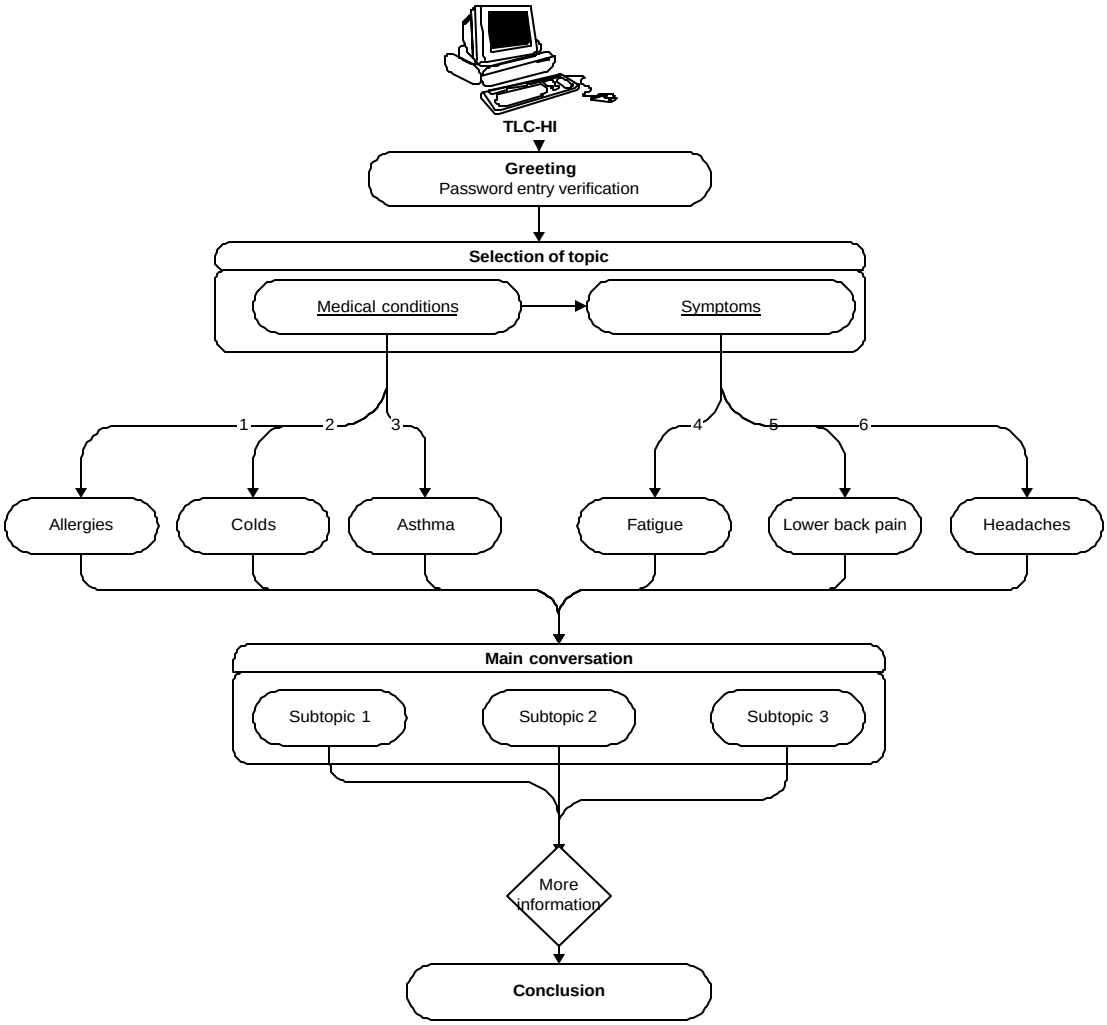
The dialogues are designed to give the user the ability to listen to or skip over specific subtopics. The conversations offer the most important information first, and then, give the user the option to listen to more detail, if desired. Long stretches of continuous "talk" by the system are avoided by organizing the information into small bites. Interactivity is optimized by delivering the information in a question and answer format.

The final step entailed programming the interactive content using the TLC technology, quality assurance testing from both a technical and clinical point of view, and converting the system into a production environment.

Description of a TLC-HI Session

The structure of a typical TLC-HI session is shown in Figure 1. Each TLC-HI user receives a TLC-Health Information manual that lists the telephone numbers to call to reach the system, a personal password, a telephone number to call for technical problems,

Figure 1. TLC-HI Dialogue Structure



a brief introduction to the system along with simple instructions on how to use the system, and a list of topics. The user dials a local or toll free number and is greeted by TLC-HI. After password verification, TLC-HI instructs the user to enter a topic of his or her selection from the printed list provided in the manual. For example, a topic "Herbal Medicine" is selected and the "conversation" begins. Throughout the "conversation" a user is asked whether he/she wishes to listen to a particular subtopic by pressing a corresponding key on the telephone keypad. This response is stored in the database. The dialogues will branch into different subtopics and additional details depending on the answers provided by the user. At the end of the "conversation", TLC-HI asks the user to rate this call and/or leave comments about the call. It follows by a closing remark, containing a reminder for the next call such as "Please, don't forget to call back again," and the call is ended.

Advantages of TLC-Health Information as a Communication Medium

Order of Presentation

One of the most useful features of the TLC-HI system is how it orders the presentation of information. The content of any single dialogue is first presented to the user in a summary form. There is no enforced order in the presentation of information in the dialogues, in other words, the logic is preserved whether the entire dialogue is listened to or a part of it. While the subtopics of a dialogue are interconnected in logic, they are not dependent on each other. For example, one may chose to listen to *Types of Allergies subtopic*, from the *Allergies and Hay Fever* dialogue, but decide to skip *Prevention Strategies,* advancing to the next subtopic - *Medications.* In such case the skipped subtopic, *Prevention Strategies*, carries no linkage between the other two, and the user will not feel a missing transitional element. The independent component structure of TLC-HI allows for easy modifications and additions as new information on the topics become available. It also allows for a user to revisit the topic, and select previously heard or not heard sub-topics.

Interactivity

A learning environment is said to be interactive if a person can navigate through, select relevant information, respond to questions using a computer input device, and solve problems.[14] Using this definition, TLC-HI is an interactive learning environment. Although the learning power of interactivity is an undergoing subject of research,[15] the interactive architecture of TLC-HI focuses on elements that keep the learner involved and engaged during the session in order to promote education. Technically speaking, TLC-HI engages the users to be specific and formulate questions to promote further investigation of the material. In these steps the users participate actively in constructing knowledge following a basic learning strategy which consists of questions and answers.

Traffic Analysis

One of the most valuable innovations that distinguishes TLC-Health Information from other available information sources is its potential traffic analysis. As it has been previously mentioned, the choices a user makes during the session are stored in the database for further evaluation. The analysis of the recorded data allows one to examine a user's interests, level of attention and need for certain types of information. Health Information dialogues provide the user with referrals to telephone numbers of useful contacts, books and Web sites of government agencies, non-for-profit organizations, public and private associations that are relevant to the user's interests. Users are urged to record this data and are given options to hear information repeated and/or spelled out. Analysis of the user's preferences for referrals, mentioned above, allows one to determine the kind of medium the user is comfortable with. Other stored user selections permit one to grade the topic by its popularity and to evaluate the interest in subtopics during the conversation. The stored data is essential for refinement of the system which can be done continuously through its operation.

Accessibility, Flexibility, Efficiency

The design of TLC-Health Information recognizes the importance of ease of access of all consumers. Thus, the only piece of equipment necessary to access the system is a telephone. A toll free dial-up number, permits consumers to access TLC from almost any point in the US and anytime. TLC-HI offers flexibility in its usage. Users are advised to call in regularly, but are not limited to any particular time or number of calls. TLC is easy to use and requires no special training nor assumes any particular knowledge or literacy level. Most calls last from 3-8 minutes depending on one's needs.

CONCLUSION AND FUTURE DIRECTIONS

Although an increasing number of individuals use the Internet to seek health information, there are substantial concerns about its quality.[6, 7, 8] The Federal Trade Commission has found more than 400 potentially false and deceptive claims on the Web[16]. These sites presented products and services that they claimed would help cure, treat, or prevent AIDS, arthritis, cancer, diabetes, heart disease, and multiple sclerosis.[16] The need for a reliable source of health care information, such as the one provided by the TLC-HI, is not debatable. In addition, accessing health care information over the Internet through the use of search engines is not an efficient process; only 20% of search results lead to relevant health information requiring most users to spend about thirty minutes searching for information.[17] Furthermore, 53% of English-language Web sites that focused on four medical conditions presented conflicting information; treatment related information had conflicts about 35% of the time.[17] TLC-HI is an interactive health care information program that has been designed using high quality clinical content and is accessible by anyone who has access to a telephone. At the present we are evaluating the utility of the TLC-HI as a source of information and its acceptability to patients and consumers.

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